Wharf; W. M'Donald, Queen-street, Glasgow; H. S. J. Medley, Parrington; Lady A. Paget, 1, Old Burlington-street; E. Shepheard, Coventry, —each 100*l.*

F. Allen, Pershore; B. Brown, George-yard, Lombard-street; Henry Brown, Boughton, Chester; H. W. Dobell, Sussex-square, Kensington; A. G. Fraser, Halifax, Nova Scotia; P. H. Green, Manchester; W. Keary, Stoke-on-Trent; J. Wayer, Astley-crescent; E. Westall, Croydon; B. Williams, Waterloo-place,—each 80*l.*

J. Burton, Princes-street City; Miss Connell, 36, St. James's-place; W. Crystall, Greenwich; W. Davidson, Glasgow; C. Dolman, Birmingham; W. Durant, Sandringham, Norfolk; F. Hooper, Worcester; H. Senior, Eye, Suffolk; Mrs. Staple, Pimlico; Mrs. J. J. Stone, Kensington-terrace, Bayswater,—each 70*l.*

J. Cobbold, Ipswich; T. Dakin, King-William-street; A. L. Davies, Carmarthen; E. Dickinson, Jerusalem Coffee-house; S. E. Doidge, Bideford; G. Harcourt, Chertsey; A. G. Niner, Regent-street; Mrs. Paget, St. John's wood; H. Renshaw, Strand; C. Rickards, Piccadilly; C. H. L. Woodd, 108, New Bond-street; T. Workman, Basingstoke,—each 60*l.*

E. Ballard, Islington; W. B. Bull, Newport Pagnel; J. Carrington, Potham, Beds; Miss Colquhoun, Walmer-lodge, Avenue-road; Halstead, Chichester; W. Howlett, Kirton Lindsay; G. K. Lancaster, Stafford-cottage, Windham-road; T. Longman, Paternoster-row; M. B. M'Farlane, Cheapside; A. M'Leod, Halifax, Nova Scotia; J. G. Plainer, Helston; J. Stewart, Bank of England; Mrs. Veal, Barnstaple; Lady Whichcote, Buckingham—each 50*l.*

D. W. Alexander, Halifax; Miss Armstrong, Stafford; A. Attwood, Gracechurch-street; W. Beckwith, Isle of Man; Mary A. Clarke, Durham-street, Strand; A. Dawson, Old Broad-street; T. Furguson, Mill-wall, Poplar; T. M. Gresham, Dublin; E. Griffith, Newton; E. Hunt, Southampton; Dr. Jones, Chester; T. Leftwich, Cumberland market; W. F. Moore, Isle of Man; J. Patten, Paddington; F. R. Perkins, Chipstead-place, Sevenoaks; G. Phillip, Liverpool; R. R., Dunchurch; A. Rowbotham, Market-place, Sheffield; Sir M. A. Shee, P.R.A., Cavendish-square; J. Simpson, 43, Newington-place, Kennington; J. Smith, 49, Long Acre; W. Stone, Darwin-street; J. Symonds, Warrington; Mrs. S. Wade, St. Albans; J. Watt, Wych-street,—each 40*l.*

Thanks to the young ladies who assisted in the distribution, moved by Dr. Dickson and seconded by Mr. Wyndham, and to Mr. Bunn, for the liberality with which he had placed the theatre at the disposal of the society, moved by Mr. Noble and seconded by Mr. J. S. Gaskoin, were carried unanimously.

Alderman Wilson proposed a vote of thanks to the honorary secretaries for their exertions in promoting the interests of the Institution, which was seconded by Mr. Cubbell (the chairman), and passed unanimously.

SUSPENSION BRIDGES.

Suspension bridges appear to be of very ancient origin; travellers have discovered them in South America, in China, in Thibet, and in the Indian Peninsula. They are mostly met with in mountainous regions, and being suspended across a deep ravine, or an impetuous torrent, permit the passage of the traveller when the construction of any other kind of bridge would be impracticable. It is not, therefore, from the celebrated nations of antiquity that the engineer has derived his first hints for the construction of suspension bridges, as neither Greece, Rome, nor Egypt is ever known to have had one, but from rude and unpolished people, the results of whose ingenuity we proceed to describe.

In South America there are numerous *rope suspension bridges* formed of the fibrous roots of the great American aloe (*Agave Americana*). The roadway is formed by covering the ropes transversely with small cylindrical pieces of bamboo. The bridge of Penipi, erected over the river Chambo, is 120 feet long and 8 feet broad; but there are others of much larger dimensions.

The utility of these bridges in mountainous countries is immense. Humboldt mentions that a permanent communication has been established between Quito and Lima by means of a rope bridge of extraordinary length, after 40,000*l.* had been expended in a fruitless attempt to build a stone bridge over a torrent, which rushes from the Cordilleras of the Andes. This is erected near Santa, and travellers with loaded mules pass over it in safety. A rope bridge will generally remain in good condition twenty or twenty-five years, though some of the ropes require renewing every eight or ten years. But composed of stronger and more durable materials than the twisted fibres and tendrils of plants, suspension bridges are found to exist in remote and semi-barbarous regions. In Thibet many iron suspension bridges have been discovered, and it is not improbable that in countries as little known and visited by Europeans, others may exist of which we have as yet received no accounts. Turner, in his "Embassy to the Court of Thibet," mentions a most remarkable bridge of this description, stretched over the Tehintchien, situate about eighteen miles from Murichom. "Only one horse is admitted to go over it at a time; it swings as you tread upon it, re-acting at the same time with a force that impels you every step you take to quicken your pace. It is constructed of five chains, which support the platform, and on which chains are placed several layers of strong, coarse mats of bamboo, loosely laid down, so as to play with the swing of the bridge; a fence on each side further secures the passenger." The date of the erection of this bridge is unknown to the inhabitants of the country, and they even ascribe to it a fabulous origin: its length is about 150 feet. In Kitcher's "China Illustrated," there is a very clear description of a Chinese iron-chain-bridge. "In the province of Junnan," says he "over a valley of great depth and through which a torrent of water runs with great force and rapidity; a bridge is said to have been built by the Emperor Mingus, of the family of Hama, in the year of Christ 65, not constructed of brick-work or of blocks of stone cemented together, but of chains of beaten iron and hooks, so secured to rings from both sides of the chasm, that it forms a bridge by planks placed under them. There are twenty chains, each of which is 20 perches, or 300 palms in length. When many persons pass over together, the bridge vibrates to and fro. It is impossible to admire sufficiently the dexterity of the architect Sinensius, who had the hardihood to attempt a work so arduous and so conducive to the convenience of travelling."

Another suspension bridge in China is described in the sixth volume of the "Histoire general des Voyages." The following is a condensed translation:—"The famous iron bridge (such is the name given to it) at Quay-Chen, on the road to Yun-Nan (Junnan?), is the work of an ancient Chinese general. On the banks of, and stretching over the Pan-ho, a torrent of inconsiderable breadth but of great depth, a large gateway has been formed between two massive pillars 6 or 7 feet broad, and from 17 to 18 feet high. From the pillars at each end four iron chains extend, on this bridge of chains thick planks laid across formed a platform. The whole is covered by a roof which rests its ends on the pillars at each side of the bank."*

Scamozzi speaks of suspension bridges existing in Europe in the beginning of the 17th century, but it is very questionable if the term he employs designates the same structure as that to which it is now applied. On the Continent no suspension bridges seem to have been erected save those of recent date, and in England the oldest bridge of the kind is believed to be the Winch Chain Bridge suspended over the Tees, and forming a communication between the counties of Durham and of York. Mr. Stephenson (*Edinburgh Philosophical Journal* for October, 1821) conjectures that the date of its erection was about 1741. It is or was (for we do not know whether it is still in existence) about 70 feet long, and rather more than 2 feet wide. The roadway was supported immediately by the chains which were stretched into a nearly straight line, and were steadied by inclined ties from the banks below. A hand-rail was added on one side only for the protection of the passengers whose footing was far from steady. But few suspension bridges and those of minor importance were erected in Great Britain before the construction of the celebrated Menai Bridge. Drewry ("Memoir on Suspension Bridges," 1832) mentions one across Gala Water, which was made of thio wires, at a cost of only about 40*l.*, although its span was 111 feet. It was erected in 1816 by a manufacturer named Lees of Galashiels. Another wire bridge, of about the same length, was built in 1817, across the Tweed at Kings Meadows, at an expense of 160*l.* The platform was 4 feet wide, and was sustained by wires radiating from the tops of two cast-iron columns at each end of the bridge. The columns were cast hollow, and within each of them was placed a verticle bar of wrought-iron 2½ inches square, to which the wires were immediately attached. Other bridges were built upon this principle, which, according to Navier, was suggested many years before by a Frenchman of the name of Povet.

In 1817, Captain (now Sir Samuel) Brown, obtained a patent for an improved method of constructing chains for suspending the roadway, and three years afterwards, had an opportunity of testing its merits in the erection of the Union-bridge across the Tweed, near Berwick, which was opened for use in July, 1820. The length of the chord-line between the points of suspension on the tops of the towers, is 449 feet, and the deflection is about 30 feet. On the 10th of August, 1820, the first stone was laid of the Menai Bridge, a noble monument of the scientific skill of the late Thomas Telford. In January, 1826, preparations were made for opening the bridge, and on Monday, the 30th, the mails drove over it for the first time. Shortly after, however (February 6th), a tremendous gale did considerable damage to the iron-work, and repeated gales during the spring, tended greatly to retard the necessary operations in repairs. But no inconvenience has since been felt, and there is reason to believe, that with ordinary care and attention this noble structure will last for ages.

In 1821, Captain Brown commenced the Trinity Suspension Pier at Newhaven, near Edinburgh, which consists of three spans of 209 feet each, with 14 feet deflection. He also constructed the Suspension Pier at Brighton, which consists of four openings of 255 feet each with a deflection of 18 feet.

In 1824, Mr. W. Tierney Clark commenced the Hammersmith Suspension Bridge, the first erected in the vicinity of London. The central opening has a chord-line of 422 feet, with a deflection of 29 feet 6 inches. This bridge was opened for use in 1827.

In 1828, Captain Brown commenced a large suspension bridge over the South Esk, at Montrose, the chord-line of which is 432 feet, and each chain extends 115 feet from the centre of the tower to the farthest end of the chamber of masonry, in which its end is secured.

After the completion of the Menai Bridge, others on the suspension principle began to be universally adopted throughout Europe, but it was not till iron-wires had been proved to be more firm than bars of a greater thickness, that these bridges received their most extensive applications.

Since 1821, Messrs. Sequin have constructed more than fifty wire-bridges in France with great success.

In a recent number of the *Pittsburgh Chronicle*, is the following account of a suspension wire bridge, now being constructed over the Alleghany:—

The suspension ropes, which extend from pier to pier in the form of an inverted arch, are to consist of seven strands of wire, each strand being about 3 inches in diameter. The ropes will then be wrapped in annealed wire (No 14) which will render it one solid mass, and as each individual wire is varnished before it is put across, and as the whole will be painted when finished and wrapped, it will be impervious to water, and consequently not liable to be weakened or impaired by the weather. On these two immense wire ropes the structure is to be suspended. But this is not the only reliance for strength. The trunk is to be constructed from pier to pier—the sides being of solid lattice-work—that is, strong beams placed in this form—XXX. The beams are to be placed contiguous to each other for greater strength, so that when finished the trunk alone, without the wire-ropes, will be a firm and strong structure, capable not only of sustaining its own weight, but also of bearing up as much additional work as a lattice-work bridge would do. In effect, the trunk is a lattice-work bridge without arches. The ropes being suspended across strong stone towers placed upon the piers, are in fact, inverted arches, capable of sustaining more than double the additional weight which the letting in of the water would place upon the trunk; the trunk itself is an independent, strong, and immovable structure, so that when

* See Navier. "Memoire sur les Ponts Suspendus."

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